

NOTES ON HIPPOBOSCIDÆ

13. A SECOND REVISION OF THE HIPPOBOSCINÆ

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Since the publication of my synopsis of the Hippoboscinae (1931, *Psyche*, XXXVII, (1930), pp. 303-326), much additional information has come to light. One new species was described recently by the late G. A. H. Bedford and I was able to study several types, including those of *H. fulva* Austen.

In the alphabetical list of names (p. 306), *martinaglia* Bedford should be inserted as the ninth valid species; *longipennis* Fabricius is the valid name of *capensis* v. Olfers, which becomes a synonym; and *variegata* Megerlé (not to be credited to Wiedemann) is the valid name of *maculata* Leach, which passes in the synonymy.

As pointed out before, the Hippoboscinae differ from other members of the family in several important characters. To those listed before may be added the presence of a pair of deep, more or less pit-like depressions, placed laterally on the suture between mesonotum and scutellum; also the well-defined pale yellow or white spots of head and thorax, which are not duplicated elsewhere in the family. While in other Hippoboscidae color differences are of little or no specific value, in *Hippobosca* the shape and arrangement of the pale spots produces a pattern to a large degree diagnostic for each species. In this respect, there is an obvious analogy to the characteristic pattern of pale spots found in many species of ticks (*Amblyomma* and *Dermacentor*).

I have been at pains to discover additional specific characters, particularly in the case of closely allied forms. The chetotaxy has been neglected thus far, yet offers reliable differences which should be investigated by the accepted bio-

metrical methods. My material is not extensive enough for the purpose. Considering only the chetotaxy of the scutellum, this sclerite in *Hippobosca* bears at the extreme apical margin and somewhat ventrally a dense fringe of short, soft hairs. Anterior to the fringe one finds groups or rows of long, stiff bristles, either black or pale-colored, which I shall call the *preapical bristles*. The groups may be either far apart and restricted to the extreme sides or more or less connected medially. In some species the bristles are placed in one row, in others they form two irregular rows or are merely bunched together. When there are many bristles, these are often mixed with a few soft, short hairs, sometimes forming a second row behind the stiff bristles. In most cases the number and arrangement of the preapical bristles is the same in both sexes. There are two exceptions. In *H. struthionis* the males have more bristles on the average than the females. In the males of *H. camelina* the preapical bristles occupy the same position as in the other species of the genus; but in the females, the bristles are placed nearer the middle, being rather discal or medio-scutellar, and are also fewer in number than in the males. Except for this case of the female *H. camelina*, there are no discal nor basal bristles, setæ or hairs on the scutellum in *Hippobosca*.

The variation of the preapical bristles of the scutellum is discussed under each species, but the following summary compares the species for diagnostic purposes. The number of specimens examined is given in parenthesis.

equina (106) : 5 to 11 bristles ♀ ♂ (average, 7).

longipennis (143) : 3 to 7 bristles ♀ ♂ (average, 5).

fulva (3) : 8 bristles ♀ ♂.

variegata (95) : 13 to 27 bristles ♀ ♂ (average, 18).

rufipes (95) : 12 to 23 bristles ♀ ♂ (average, 17).

hirsuta (6) : 14 to 18 bristles ♀ ♂.

martinaglia (not seen).

struthionis (23) : 4 to 12 b. ♀ (average, 6) ; 8 to 15 b. ♂ (average, 10).

camelina (31) : 3 to 8 b. ♀ (average, 5) ; 11 to 22 b. ♂ (average, 14).

In *Hippobosca*, the integument of the abdomen, behind the usual large tergal and small sternal sclerotized basal plates, is mostly soft and extensible. All species I have seen have

two pairs of sclerotized subapical (lateral) plates in both sexes. In the males of *equina* and *longipennis*, the anterior pair is small and fused with the median tergal plate, yet recognized by the very long setæ it bears. In addition, these two species have in both sexes three median tergal sclerotized plates, which are much smaller in the female than in the male. Median tergal plates are lacking in both sexes of *variegata*, *rufipes*, *struthionis*, and *hirsuta*, and in the female of *camelina*. The male of *camelina*, however, has an extensive anterior sclerotized median plate, immediately behind the basal tergal sclerite of the abdomen, and posteriorly a pair of small, median tergal plates. In the female of *longipennis* and *equina* the anterior pair of subapical (lateral) plates is slightly smaller than the posterior pair; it is larger than the posterior pair in the female of *variegata*, *hirsuta*, *camelina* and *struthionis*; and both pairs are about the same size in the female of *rufipes*. In the males of *variegata*, *rufipes*, *hirsuta*, *camelina* and *struthionis*, the anterior pair of subapical plates is very large, the posterior pair very small and readily overlooked. I have not examined the structure of the abdomen of *fulva* and *martinaglia*.

In the male genitalia, the claspers (or parameres) are very similar in *equina*, *longipennis*, *fulva*, *variegata*, *rufipes* and *struthionis*, being more or less slender, straight and rod-like, ending in a point. In *camelina* they are of much the same rod-like type, but thicker, curved in profile and ending in a blunt, somewhat knobbed point. They are quite aberrant in *hirsuta*, being thick and beam-like, with a broadly truncate and slightly emarginate tip. The genitalia of *martinaglia* are unknown.

To sum up, the nine species of *Hippobosca* now recognized may be divided into four groups, expressing relationship based on structural characters: (1) *equina*, *longipennis* and *fulva*; (2) *variegata*, *rufipes*, *hirsuta* and possibly *martinaglia*; (3) *struthionis*; (4) *camelina*.

The following key supersedes that of my earlier paper (pp. 308-309). *H. martinaglia* is inserted from the description only.

1. Second longitudinal vein ($R_2 + 3$) long, about as long as or longer than last section of third longitudinal, reaching costa much beyond tip of first longitudinal

- (R₁) and usually apicad of anterior cross-vein (r-m); last section of costa about three times the length of penultimate section or shorter. Base of third longitudinal vein (R₄ + 5) bare. One pair of vertical bristles. Preapical bristles of scutellum few (3 to 11). Abdomen with three median tergal sclerotized plates in both sexes (in *equina* and *longipennis*; not known in *fulva*). Two pad-like pulvilli at sides of bristle-like empodium, one much larger than the other. Parameres of male genitalia slender, rod-like, ending in a point 2
- Second longitudinal vein short, shorter than last section of third longitudinal, reaching costa together with or close to tip of first longitudinal; last section of costa at least five times the length of penultimate section... 4
2. Larger species, the wing 6 to 8.5 mm. long. Apical lobes of fronto-clypeus irregularly and broadly triangular, their inner margins curved. Scutellum fuscous to ferruginous laterally, yellowish-white medially, rarely more extensively yellowish; with a regular row of 5 to 11 preapical bristles (usually 6 to 8), divided into two groups. Wing veins as a rule rufous to dark brown *H. equina*
- Smaller, the wing at most 6 mm. long. Scutellum as a rule entirely or nearly entirely yellowish or ivory-white 3
3. Wing 5 to 6 mm. long. Apical lobes of fronto-clypeus regularly and sharply triangular, separated by a broad notch, their inner margins nearly straight. Scutellum with 3 to 7 preapical bristles (usually 5 or 6). Wing veins mostly pale testaceous, usually with some darker stretches *H. longipennis*.
- Wing 4.2 to 4.5 mm. long. Apical lobes of fronto-clypeus irregularly and broadly lobular, separated by a narrow slit, their inner margins curved. Scutellum with about 8 preapical bristles *H. fulva*
4. Base of third longitudinal vein (R₄+5) setulose over some length on the upper side. One pair of vertical bristles. No median tergal plates in both sexes (in *variegata*, *rufipes* and *hirsuta*; probably also in *mar-*

- tinaglia*). Only one pulvillus well-developed, the other rudimentary 5
- Base of third longitudinal vein bare 8
5. Second longitudinal vein very short, forming an oblique cross-vein which ends in the first longitudinal and runs from opposite or apicad of upper tip of anterior basal crossvein (M_3) to basad of anterior cross-vein (r-m). Frons distinctly narrower at occiput than at fronto-clypeus, the postvertex much longer than wide. Scutellum as a rule with three ivory-white spots, the largest in the center; with 13 to 27 preapical bristles (usually 16 to 20), in one or two irregular and fairly continuous rows. Parameres of male genitalia slender, rod-like, ending in a sharp point. Wing 7 to 8 mm. long *H. variegata*.
- Second longitudinal vein longer and more slanting, ending in costa at or beyond tip of first longitudinal and running from basad of upper tip of anterior basal cross-vein to opposite or basad of anterior cross-vein 6
6. Smaller, the wing 4.5 mm. long. Frons wide, not appreciably narrower at occiput than at fronto-clypeus, the postvertex much wider than long. Mesonotum reddish-brown, with an anterior median dark band extending posteriorly to near the transverse suture where it is more or less forked. Scutellum entirely yellowish-white; with relatively few (probably eight to ten) preapical bristles. Mesonotum moderately bristly, bare in the center *H. martinaglia*
- Larger, the wing 6.5 to 9 mm. long. Frons narrower, the postvertex nearly as long as wide or slightly longer. Color pattern of mesonotum different. Preapical bristles of scutellum more numerous (12 to 23) 7
7. Frons distinctly narrower at occiput than at fronto-clypeus. Scutellum very wide and nearly rectangular, with a median, rufous and two lateral, ivory-white spots; with 12 to 23 heavy preapical bristles (usually 14 to 20), placed in one regular, almost continuous row. Mesonotum moderately bristly, bare in the cen-

ter. Legs bright reddish-brown. Parameres of male genitalia slender, rod-like, ending in a blunt point.

Wing 7 to 9 mm. long *H. rufipes*

Frons very slightly or not narrower at occiput than at fronto-clypeus. Scutellum narrower and less rectangular, with a median ivory-white spot; with 14 to 18 soft and pale preapical bristles, placed in two irregular, more or less connected groups. Mesonotum very bristly, also in the center. Legs rufous-yellow. Parameres of male genitalia thick, beam-like, truncate and slightly emarginate at tip. Wing 6.5 to 8 mm. long *H. hirsuta*

8. Two or three pairs of vertical bristles. Fronto-clypeus shorter than its distance from the occipital margin. Postvertex shorter than mediovertex, the latter much narrowed medially by the broad inner orbits. Anterior basal cross-vein (M_3) very oblique and nearly its own length from anterior cross-vein (r-m). Scutellum semi-elliptical, the hind margin distinctly convex and slightly projecting medially; in the female with 3 to 8 discal bristles (usually 4 to 6), placed in two linear groups; in the male with 11 to 22 preapical bristles (usually 12 to 15), placed in two irregular groups. No median tergal plates in the female; the male with one large median plate behind the basal tergal sclerite and a pair of small median tergal plates posteriorly. No pad-like pulvilli; bristle-like empodium bare, except at base. Parameres of male genitalia rod-like, but curved upward, the apex slightly swollen and knob-like. Wing 9 to 10 mm. long *H. camelina*

One pair of vertical bristles. Fronto-clypeus nearly as long as its distance from occipital margin. Postvertex as long as or longer than mediovertex, the latter moderately narrowed by the inner orbits. Anterior basal cross-vein short, almost vertical upon the fourth longitudinal and more than twice its length from anterior cross-vein. Scutellum nearly rectangular, the hind margin more straightly truncate; in both sexes with preapical bristles placed in two widely separated lateral groups, more numerous in the male

(8 to 15, usually 9 to 12) than in the female (4 to 12, usually 5 to 7). Abdomen in both sexes without median tergal plates. Two pad-like pulvilli; empodium feathered. Parameres of male genitalia slender, rod-like, ending in a sharp point. Wing 7 to 7.5 mm. long *H. struthionis*

1. *Hippobosca equina* Linnæus. — The locality "Reshadie" is near Smyrna.

Additional Specimens Examined. — Norway: Smaalene. — Esthonia, one female off a duck, *Mergus* (or *Merganser*) *serrator* Linnaeus (sent by G. B. Thompson), an accidental host. — Finland: Kustö (C. Lundström). — Denmark: Seelland (Univ. Zool. Mus., Copenhagen). — Austria: Grünbach, Schneeberg region (Handlirsch). — Hungary. — Roumania: Bihar Mts. (K. Jordan); Herkulesbad (W. Rothschild and E. Hartert). — Bulgaria: Aladza near Varna; Bela Cerkva, Rhodope (Zerny). — Jugo-Slavia: Zljeb, New Montenegro; Stolac, Herzegovina (Penther); Bosnia. — France: Argentat, Auvergne, off a cow. — Italy: Triest; Taranto; Pola. — Corsica: Vizzavona (M. E. Mosely); Corte (M. E. Mosely); La Poce de Vizzavona (Yerbury); Ajaccio (F. Gugliemi). — Spain: Murcia (G. L. Boag); Sierra de Guadarrama, 6,000 to 8,000 ft. (B. Uvarov); Algeciras (Zerny); Noguera near Albaracin, Aragon (Zerny). — Canary Islands: La Caldera, Las Palmas Id. (W. M. Wheeler); Sa Cruz, Teneriffe; Puerto Cabias, Buenaventura. — Madeira (Lowe). — Albania: Kula Ljums; Hodzha near Prizren; Pashtrik; Korab; Durazzo. — Greece: Stavros, Macedonia (J. Waterston); Saloniki (J. Waterston); Helmas (Fonberg); Taygetos; Koystalopyghi (A. H. G. Alstoni); Attica; Poros; Vrissula; Mt. Pangaion; Struma; Carvalli (R. C. Shannon). — Asia Minor (Anatolia): Namerun; Cilician Taurus (Prince Abersperg); Sabandscha to Eskischebir; Ephesus. — Transcaucasia: Sagalu on Lake Göktschai (Zugmayer). — Turkestan. — Persia (Iran): Nissa, Elburs Mts. (Brandt); Tsiang-Kanspe, E. Persia (A. Teufigi); Enzeli, N. W. Persia (P. A. Buxton). — Arabia: Akaba, Hejaz (W. M. Mann). — Palestine: Haifa (P. J. Barraud); Beisan, Jordan Valley (P. A. Buxton). — Cyprus: Limasol (G. A. Mavromoustakis). — Egypt: Tisfa (Zool. Dept. Univ. Egypt). —

Libya: Dernah (Klaptocz). — Tunis: Gabes (Mik). — Algeria: Hamman Rirha; Hamman Meskoutine; El Kantara; Biskra (W. Rothschild and E. Hartert). — Morocco: Aguelman Sidi Ali bu Mohammed, Middle Atlas, 6,500 ft. (K. Chapman and J. W. S. Pringle); Ijoukak, Great Atlas, 3,900 ft. (K. H. Chapman and G. A. Bisset); Arround, Atlas, 1,950 m. (Ebner). — Australia: Sydney, on a horse imported from New Caledonia. — New Hebrides: Tanna Id. (E. Robertson); Vila, Efate (or Sandwich) Id., very common on horses (P. A. Buxton). — Philippines: Alabang, Rizal (M. B. Mitzmain). — Amboyna, off cattle (F. Muir). — Singapore (F. Muir).

The preapical bristles of the scutellum vary from 5 to 11 in 106 specimens examined (58 ♀ and 48 ♂), from 22 localities, 85 specimens having from 6 to 8 bristles. The specimens fall in the following groups: with 5 bristles: 3 (1 ♀, 2 ♂); 6b.: 28 (17 ♀, 11 ♂); 7b.: 22 (9 ♀, 13 ♂); 8b.: 35 (24 ♀, 11 ♂); 9b.: 10 (4 ♀, 6 ♂); 10b.: 7 (3 ♀, 4 ♂); 11b.: 1 (♂). There is no evidence of any sexual difference in this character. No locality is represented by enough specimens to make a further analysis of any significance. The bristles are evenly divided between both sides in 69 specimens, unevenly in 37, the uneven groupings observed being 2 + 3, 3 + 4, 3 + 5, 4 + 5, and 5 + 6.

The frons, in the male, is nearly parallel-sided and about as wide as an eye; in the female it is slightly widened medially, where it measures a little over the width of an eye.

In addition to the average larger number of preapical bristles of the scutellum, *H. equina* differs also from *H. longipennis* in the shape of the tergal plates of the abdomen. In the female of *H. equina*, the three median, setulose tergal plates are larger than in the female of *longipennis*, more transverse and ribbon-shaped, the median plate only slightly smaller than the hindmost plate, which is nearly as large as the anterior pair of subapical (lateral) plates. The median plates bear many more setae than in *longipennis*. In the male of *equina*, the three median tergal plates are large and ribbon-like, the hindmost (or third) plate fused with the anterior pair of ovate, widened subapical (lateral) plates (bearing longer bristles than the median plate proper). The shape and arrangement of the tergal plates

are shown correctly by Ferris (1930, Philippine Jl. Sci., XLIII, p. 540, fig. 1 ♀, and p. 543, fig. 4a ♂).

The claspers (or parameres) of the male genitalia are slender, rod-like and regularly pointed at apex. They are figured in side view by J. I. Roberts (1927, Ann. Trop. Med. Paras., XXI, Pl. III, fig. 8); seen from above they are much narrower.

2. *Hippobosca longipennis* Fabricius, 1805. — A study of Fabricius' two types, marked "ex Tranquebar (Mus. Dom. Lund)", at the University Zoological Museum, Copenhagen, shows that they are the species commonly known as *H. capensis* v. Olfers (1816), *H. francilloni* Leach (1817), or *H. canina* Rondani (1878). Why Fabricius wrote "Caput et thorax ferruginea immaculata" is a mystery, as both his types show the characteristic *capensis* pattern. A specimen from Kalewa, Upper Burma, named "*longipennis*" by Major Austen, was studied at the British Museum and showed no structural characters differentiating it from the usual *H. capensis*. Fabricius' name antedates all other designations for the species, which is extremely variable in color. I have also seen, at the British Museum, a specimen of *H. francilloni*, apparently labelled by Leach and which may be the type, although it is not marked as such.

Additional Specimens Examined. — Bulgaria: Sredne near Russe. — Greece: Struma (R. C. Shannon). — Transcaucasia: Sagalu on Lake Göktschai (Zugmayer). — Transcaspia: Imam-Baba, Merv District (L. Mistschenko). — Persia (Iran): Keredj, 40 Kilom. from Teheran (Brandt); Dschulfa, N. W. Persia. — Mesopotamia (Iraq): Djerabis; Assur; Daurah (A. D. Fraser); Bagdad (T. C. Connor); Amara (T. C. Connor). — Syria: Beirut (E. S. Sewell). — Palestine: Amman, E. of Jordan (P. A. Buxton). — Arabia: Ras Fartak, Hadramaut (Simony). — Cyprus: Larnaca, off cow. — Egypt: Tisfa (Zool. Dept. Univ. Egypt). — Libya: Bengasi. — Tunis: Gabès. — Morocco: Marrakesh (G. B. Fairchild). — Anglo-Egyptian Sudan: Lugud, Darfur Province (H. Lynes); Khor Arbaat, Port Sudan. — Kenya Colony: Lake Jipe; Marsabit, Rendili Nyoro (C. A. Neave); Turkana District; Merifano (McArthur); Voi (Tate); Lemek, Masai Reserve (A. O. Luckman). — Tanganyika Territory: Valley of Ruaha River, N. Uhehe; Morogoro, Uluguru (A. G. Wilkins); W. shore of

Lake Manyara (B. Cooper); Mt. Meru, off lion (B. Cooper); Ngare Nairobi, W. Kilimanjaro, 4,500 ft. (B. Cooper); Shinyanga (N. C. E. Millar).—British Bechuanaland: Ngamiland (G. D. H. Carpenter); Ghanzi, Monfalatseka, Ngamiland, off dog (J. Maurice).—India: Quetta, Baluchistan (D. Harrison); Nedungadu (P. S. Nathan); Arbham, Vizagapatam (R. Senior-White); Chipurupalle, Vizagapatam (R. S. Patuck); Kangra Valley, Punjab (Dudgeon); Dehra Dun; Bangalore; Bhowali, Kumaon, 5,700 ft. (Imms); Allahabad; Bandra (Javakar).—Ceylon: Madulsima; Banhar (R. Senior-White); Trincomali.—Assam: Mungpoo, Reang River (R. Senior-White).—Indo-China: Than-Moi, Tonkin (H. Fruhstorfer).—China: Macao (F. Muir); Tshusiung, Yunnan, 1,900 m. (Handel-Mazzetti); Tsinan, Shantung (E. Hindle); Hanchow, off dogs (Rose); Kachek, Hainan Id. (L. Gressitt); Peiping; Yen-Ping.—Manchuoko (Manchuria): Harbin (Jettmar).

The preapical bristles of the scutellum vary from 3 to 7 in 143 specimens examined (79 ♀ and 64 ♂), from 23 localities, 126 specimens having 5 or 6 bristles. The several numbers are represented as follows: with 3 bristles: 1 (♂); 4b.: 3 (1 ♀, 2 ♂); 5b.: 19 (11 ♀, 8 ♂); 6b.: 107 (60 ♀, 47 ♂); 7b. 13 (7 ♀, 6 ♂). There is apparently no sexual difference in this character. The number from any one locality is too small for further analysis. The bristles are evenly divided in 110 specimens, unevenly in 33, the uneven groups observed being 1 + 2, 2 + 3, and 3 + 4.

H. longipennis differs from *H. equina* in the shape of the tergal plates of the abdomen, the difference being more striking in the male than in the female. In the female of *H. longipennis* the three median, setulose sclerotized plates are very small, ovate or reniform, the second smaller than either the first or the third, the third much smaller than the anterior pair of subapical (lateral) plates. In the male, the three median plates are large and ribbon-like, much of the same shape as in the male of *H. equina*; but the hindmost (or third) plate is connected laterally with a pair of small, attenuated lateral subapical plates (recognizable by their bearing longer setae than the median plate proper). No adequate figures of this species have been published.

The claspers (or parameres) of the male genitalia are very similar to those of *H. equina*.

Historical Note. — There is every reason to believe that *Hippobosca longipennis*, the dog-fly of the Near and Far East, was well known by the ancient Greeks and Romans, as it is particularly abundant in the countries bordering the eastern Mediterranean. Many are the references to "*kunamuya*" (in Greek) or *Cynomya* in the classic literature and early scientific writings. Thus, in the Iliad, Ares, the god of war, upbraids Athene: "You dog-fly, why do you sow strife among the Gods? . . ." (Bk. 21, 394). Elsewhere (Bk. 21, 421) Athene exclaims: "Now watch that dog-fly [meaning Aphrodite] leading Ares through the free-for-all. . . ." ¹ I am also inclined to think that the Greek word "*kunoraistai*" or dog-destroyers, used in the Odyssey (XVII, 300) and later by Aristoteles, covered the ectoparasites of dogs in general, hippoboscid flies as well as ticks. Oudemans (1926, Tijdschr. v. Entom., LXIX, Suppl., pp. 49-59) claims that both "*kunoraistai*" and "*kunamuya*" were used by the Greeks for dog ticks only (*Ixodes reduvius* Linnaeus). He is evidently unaware of the abundance of *Hippobosca longipennis* on dogs in the Orient. It seems most improbable that the Greeks would have called a tick a fly, since they had a special word for ticks ("*krotones*") and must have been well acquainted with both types of parasites. Moreover, the hippoboscid attracts more readily the attention and is more loathsome to the layman than the tick, owing to its habit of scurrying about in the fur and of flying from one dog to another or even onto people. Hence the use of the word "dog-fly" as a reviling or scurrilous epithet. ²

¹The exact dating of the collection of epic poems now called the Iliad and credited to Homer is a matter of speculation. Probably they had more or less crystallized into their present form by the eighth century B. C.

²Oudemans also claims that the "*muscæ*" or flies mentioned by Varro, Columella, Plinius and others as causing sores in dogs, were ticks. But in warm countries certain biting flies, such as *Stomoxys* and *Phlebotomus*, may cause true sores on the ears of dogs. Oudemans is apparently also mistaken in criticizing Albertus Magnus' use of the expression "*muscæ bestiarum, quae dicuntur cynomiæ sive muscæ caninæ*" (De Animalibus Libri XXVI, 1260). Albertus, in my opinion, alluded correctly to the winged hippoboscids which in southern Europe infest horses and cattle, as well as dogs; the two species being so much alike that laymen would naturally call them by the same name. In his second volume, Oudemans (1929, pp. 150-151) is quite elated over

Dr. Gaines Kan-chih Liu has called my attention to references to dog-flies in the early Chinese medical literature and has kindly translated some of these for my paper. In the "*Chi Tung Yeh Yu*," by Chow Mi (who lived 1232 to 1308), one reads: "A colleague of mine, Chen P'o, of Quo Chang, is an old scholar. His grandson, when three years old, was seriously ill with fever for a week, after which "to" (or small-pox) broke out, the whole body turning black and the lips being icy cold. After all remedies had failed, the grandfather went to the temple to pray God for help. There he met a stranger, who, upon learning of the case, told the grandfather how to cure it. The prescription consisted of seven dog-flies, ground into a powder and taken with wine. The medicine was very effective and the child soon was in good health, the black color disappearing." In the later "*Pen Tsao Kang Mu*" (1578), by Li Shih-chen, one finds: "Dog-flies live on the body of the dog. They can fly, are yellow and fly-like and have a hard skin. They have a sharp beak and suck the blood of the dog. Formerly they were not known to be used in Medicine; but recently they have been recommended by the *Chi Tung Yeh Yu* for curing small-pox and by the *Yi Fang Da Chien* for malaria. It seems to me that they must act like the cattle-lice and the *chufoo* (or sawbugs). For malaria, the flies, after removal of the appendages, are made into pills with dough. They should be taken the morning of the day an attack of fever is due and the cure will be successful if vomiting is provoked. Another method is to make the flies into pills with wax and take the pills with wine. For small-pox and skin troubles, soak the fly in wine and then take both the fly and the wine." Finally the "*Chien Wu*" (1582), by Li Su, says: "The dog-flies deposit among the hairs of the dog their nits (puparia), which after molting become flies. They always live on the back of the neck, where they bite frequently and where the dog cannot reach them with its mouth or paws."

3. *Hippobosca fulva* Austen. — Through the courtesy of

his discovery that the Archbishop Eustace of Saloniki, in his Commentary of the Iliad, suggests that the Greek word "*kunamuya*" (which he proposes to emend to "*kunomuya*") evidently meant the tick. But this statement proves only that the Archbishop was more proficient in philology than in natural history.

the late Major Austen, I was able to examine the holotype and paratype at the British Museum. This species, which has not been figured, is close to *H. longipennis*, the most important differences being given in the key. In addition, the vertex is somewhat narrower than in *longipennis*, with the inner margins slightly converging toward the occiput; the postvertex is shorter; the inner orbits (or parafrontalia) are narrower and of more uniform width throughout; the fronto-clypeus also narrower. The insect is mostly reddish-yellow; but scutellum, postvertex and fronto-clypeus are almost wholly pale ivory-yellow. I have seen also a male from Tanganyika Territory (West shore of Lake Manyara). This sex is almost exactly like the female. It has eight strong pale-colored preapical bristles on the scutellum (also present in both types), placed in a single row and widely divided into two groups of four each. The structure of the abdomen is not known, but is probably similar to that of *equina* and *longipennis*, with minor differences in the relative size of the median tergal plates.

In the male of *fulva* examined, the parameres of the genitalia are similar to those of *equina* and *longipennis*, but the terminal point is blunter. *H. fulva* and *H. martinaglia* are the smallest members of the genus.

4. *Hippobosca variegata* Megerlé von Mühlfeld, 1803, (actual date of publication!), Appendix ad Catal. Insect. Nov. 1802 Vienna Austriae Vendita, p.[14] (unnumbered) (Bengal).

Synonyms: *H. maculata* Leach, 1817; *H. bipartita* Macquart, 1843; *H. aegyptiaca* Macquart, 1843; *H. fossulata* Macquart, 1843;¹ *H. sudanica* Bigot, 1884; *H. sivaie* Bigot, 1885; *H. calopsis* Bigot, 1885; *H. aegyptiaca* var. *bengalensis* Ormerod, 1895.

H. variegata appears to be the oldest valid name for this species, the date 1823 given by Wiedemann being erroneous (see Schenkling 1935, Arch. Morph. Taxon. Entom., Berlin-Dahlem, II, p. 156). The original description is of the briefest: "ex Beng. Aff. equin. sed maj. magisque varieg. (1 Exemplar)." Yet it is sufficient to validate the name, especially in view of the fact that Wiedemann (1830,

¹Macquart's three names should be dated 1843, when the Mém. Soc. Sci. Lille for 1842 were actually published.

Aussereurop. Zweifl. Ins., II, p. 603) based the more detailed and fully recognizable description of his *Hippobosca variegata* in part upon Megerlé's specimen.

I have seen, at the University Zoological Museum in Copenhagen, the fly from Tranquebar mentioned by Fabricius (1805, Syst. Antliat., p. 338) as a variety of *H. equina*. It is *H. variegata* and may well have been the specimen which Wiedemann mentioned from Tranquebar. I have also seen Leach's type of *H. maculata* at the British Museum. According to the label it came from Bengal.

Additional Specimens Examined. — French West Africa: Zinder, Niger River, off cattle and horses (A. Buchanan). — Gold Coast: Salaga, N. Terr., off cattle (F. J. A. Beringer); Yegi, N. Terr.; Accra (J. W. S. Macfie); Obuasi, Ashanti (W. M. Graham). — Northern Nigeria: Kaduna (J. J. Simpson); Azare (L. Lloyd); Zungeru, off horses. — Southern Nigeria: Lagos (C. B. Philip); Olokemeji, Ibadan. — Cameroon: Bamum. — Belgian Congo: Sankuru District, 5° S., 26° E. (A. Yale Massey). — Anglo-Egyptian Sudan: Khor Hanoieit, Port Sudan; Khartoum (S. Hirst); Erkowit, Red Sea Hills, biting man (J. G. Myers); near Meshra, Equatoria biting man (J. G. Myers). — Egypt: Luxor (Reimoser). — Ethiopia: Hawash River, W. of Mt. Zaquala, 6,000 ft. (J. O. Couper); Maraquo (O. Kovacs). — Uganda: Mt. Debasien, 5,000 ft. (A. Loveridge). — Kenya Colony: Nakuru (van Someren). — Tanganyika Territory: Kigonsera (J. N. Erth). — Natal: Durban. — Madagascar: Betsiriry District, west of S. Central Plateau, off mules (F. P. Porter); Tsaratanana, N. Central District (W. C. Holden); Ampoza (E. I. White); Tanovana, Oriental Forest District (between Tamatave and Tananarive. — C. Lambertson). — Mesopotamia (Iraq): Daurah (A. D. Fraser). — India: Calcutta (Brunetti); Bhowali, Kumaon, 5,700 ft. (Imms); Deccan (Fischer); Mukteswar, United Prov. (J. D. R. Holmes); Pusa, Bihar, off cattle (R. Senior-White); Tranquebar. — Ceylon: Banhar (R. Senior-White); Matala, off horse (R. Senior-White); Luduganga, off cattle (R. Senior-White); Habarane, off cattle (R. Senior-White); Peradenyia, off cattle (A. Rutherford); Dambula, off cattle (L. G. Saunders); Hamsantota; Madulsima; Diyawa, 4,000 ft. — Assam: Coonor, off cattle (R. Senior-White);

Baranri (R. Senior-White). — Timor. — Celebes: Manado, off horse (F. C. Kraneveld).

The preapical bristles of the scutellum are pale-colored and unevenly developed, usually placed on two irregular rows, the two lateral groups more or less connected in the middle. Counting only the heavy bristles and neglecting the small, hair-like ones, their number varies from 13 to 27 in 95 specimens examined (49 ♀ and 46 ♂), from 12 localities, 68 specimens having from 16 to 20 bristles. The specimens show the following grouping: with 13 bristles: 2 (all ♀); 14b.: 1 (♀); 15b.: 5 (2 ♀, 3 ♂); 16b.: 7 (6 ♀, 1 ♂); 17b.: 15 (7 ♀, 8 ♂); 18b.: 15 (4 ♀, 11 ♂); 19b.: 22 (13 ♀, 9 ♂); 20b.: 9 (6 ♀, 3 ♂); 21b.: 7 (4 ♀, 3 ♂); 22b.: 2 (1 ♀, 1 ♂); 23b.: 3 (2 ♀, 1 ♂); 24b.: 4 (1 ♀, 3 ♂); 25b.: 2 (all ♂); 27b.: 1 (♂). There is seemingly no sexual difference in this character. In one lot of 30 specimens (10 ♀, 20 ♂) from Aden, off cattle, the bristles vary from 13 to 22, but 25 specimens have from 16 to 20 bristles. The bristles are evenly divided between both sides in 37 specimens, unevenly in 58, the uneven groupings observed being 6 + 7, 6 + 8, 7 + 8, 8 + 9, 9 + 10, 10 + 11, 11 + 12, 12 + 13, and 13 + 14.

In *H. variegata*, the dorsum of the abdomen bears no median tergal sclerotized plates in either sex. In the female, the anterior pair of subapical (lateral) plates is somewhat larger than the posterior pair. In the male, the anterior pair is very large, so that the two plates nearly touch medially; the posterior pair is very small and hidden in a dorsal view. The abdomen of the female is shown correctly by Ferris (1930, Philippine Jl. Sci., XLIII, p. 545, fig. 5). There is no good figure of the male.

The claspers (or parameres) of the male genitalia are straight and rod-like, rather abruptly narrowed about mid-length and then very slender to the pointed tip.

5. *Hippobosca rufipes* v. Olfers.

Additional Specimens Examined. — Natal: Durban, off cattle (W. C. C. Pakes). — Cape Province: Van Rhyn's Pass (T.D.A. Cockerell); Milnertown near Cape Town (R. E. Turner); Waku (J. Bruce-Bays); Matjesfontein (R. E. Turner); Erraha (E. Gough). — South West Africa: Tsau, Great Namaqualand (Pösch); Otyivarongo, Damaraland (de

Schauensee); Windhoek to Gobabis (de Schauensee); Okahandja (R. E. Turner; J. Ogilvie); Otavifontein (K. Jordan); Usakos (J. Ogilvie); Hoffnung (K. Jordan).—Orange Free State: North Bank Halt, Norvals Poort (J. Ogilvie); Cotzies' Farm (W. L. Distant).—Bechuanaland Protectorate: Mongalatsela, Ghanzi, Ngamiland, off horse and off steinbok (J. Maurice).—Southern Rhodesia: Victoria Falls (R. Lowe Thompson).—Northern Rhodesia: Lunda, near Congo border (H. S. Evans).—Portuguese West Africa: Benguela, off cattle (W. C. C. Pakes).—Tanganyika Territory: Mt. Meru, 4,500 to 5,000 ft., off eland (B. Cooper); Ngare Nairobi, W. Kilimanjaro, 5,000 ft. (B. Cooper); Ngaserai, W. Kilimanjaro, 3,000 ft. (B. Cooper).

The number of heavy, black preapical bristles of the scutellum is quite variable in this species and apparently shows no sexual difference. In 95 specimens examined (69 ♀ and 26 ♂), from 14 localities, the total number varies from 12 to 23, but 82 specimens have from 14 to 20 bristles. The specimens are distributed as follows: with 12 bristles: 2 (1 ♀, 1 ♂); 13b.: 5 (4 ♀, 1 ♂); 14b.: 10 (8 ♀, 2 ♂); 15b.: 10 (all ♀); 16b.: 7 (6 ♀, 1 ♂); 17b.: 17 (13 ♀, 4 ♂); 18b.: 18 (11 ♀, 7 ♂); 19b.: 12 (8 ♀, 4 ♂); 20b.: 8 (4 ♀, 4 ♂); 21b.: 5 (4 ♀, 1 ♂); 23b.: 1 (♂).

Most localities are represented by one or a few specimens. In a series of 67 specimens taken off cattle at Windsorton, Cape Province, the proportion is as follows: with 13b.: 3 (all ♀); 14b.: 4 (3 ♀, 1 ♂); 15b.: 9 (all ♀); 16b.: 5 (all ♀); 17b.: 12 (9 ♀, 3 ♂); 18b.: 15 (10 ♀, 5 ♂); 19b.: 8 (5 ♀, 3 ♂); 20b.: 5 (2 ♀, 3 ♂); 21b.: 5 (4 ♀, 1 ♂); 22b.: 1 (♂). The bristles are more often unevenly divided between both sides (unevenly in 58 specimens, evenly in 37), the two groups only narrowly divided, so that the row is fairly continuous. The uneven groupings observed were 6 + 7, 7 + 8, 8 + 9, 6 + 8, 7 + 9, 8 + 10, 9 + 10, 9 + 11, 10 + 11, 9 + 12, and 11 + 12.

The structure of the abdomen of *H. rufipes* is similar to that of *H. variegata*. It is correctly shown for the female by Austen (1909, Illustr. African Blood-Suck. Flies, Pl. XIII, fig. 100).

The parameres of the male genitalia are straight and

rod-like, abruptly narrowed at basal third, beyond which they are thicker than in *H. variegata* and blunter at the pointed apex.

6. *Hippobosca hirsuta* Austen. — I have seen the types of the typical form and the var. *neavei* Austen at the British Museum.

Additional Specimens Examined. — Uganda: near Lake Albert (H. Hargreaves). — Nyasaland: Akamanga, Runyinya River, N. Nyasa, off waterbuck (J. B. Davey).

The preapical bristles of the scutellum are much weaker in this species than in most other members of the genus, and pale-colored. In the few specimens seen their total number varies from 14 to 18 (1 with 14, 1 with 15, 1 with 16, and 1 with 18, for the males; 1 with 14 and 1 with 16, for the females).

The structure of the abdomen is similar to that of *H. variegata* in both sexes.

The parameres of the male genitalia differ from those of all other species of the genus. They are broad and thick, beam-like, slightly wider basally and apically in side-view. The apex is straightly truncate, shallowly and evenly emarginate, so as to produce two blunt edges, one dorsal and one ventral.

7. *Hippobosca martinaglia* Bedford, 1936, Onderstepoort Jl. Vet. Sci. An. Ind., VII, pt. 1, p. 67, fig. (on p. 68) (♀ ♂; off Impalla, *Aepyceros melampus* (Lichtenstein); Bar R. Ranch, Swaziland, South Africa).

In the absence of specimens, I have inserted this species in my key on the assumption that there are setæ on the basal section of the third longitudinal vein and that only one of the pulvilli is well-developed, neither character being mentioned by the author. From the figure and description, it appears to be closest to *H. hirsuta*, likewise found on antelopes. It differs in the smaller size, the few short black setae of the mesonotum, the few preapical bristles of the scutellum, the wider frons, the narrower inner orbits or parafrontalia (less than half the width of the mediovertex or frontalia), and the short, semi-elliptical postvertex. The second longitudinal vein is described as "long", but the figure shows it to be "short", reaching the costa a short distance beyond the

tip of the first longitudinal vein, so that the last section of the costa is about six times the length of the penultimate section. No median tergal plates are shown in the figure of the female. The coloration seems to fit some of my specimens of *H. longipennis (capensis)*, but the second longitudinal vein is much shorter than in that species. The venation also separates *H. martinaglia* from *H. fulva*, a fly of about the same size, likewise found on antelopes.

The original description is reproduced, as it appeared in a periodical inaccessible to most entomologists: "A small species; length of wing 4.5 mm. Head about as wide at the occiput as at the fronto-clypeus, reddish-brown, the frontal stripe slightly darker; posterior margin of head fringed with minute, thick-set setæ, and a long seta at the base of each eye; palpi dark brown, clothed with short setae of the same colour. Thorax reddish-brown, with a median dark band extending backwards almost to the transverse suture; this band is forked posteriorly, usually more so than in the figure, and in one specimen is completely divided down the middle by a narrow line; on each side of the posterior portion of the median band there is a dark transverse band. On each side beneath the transverse suture there is a narrow transverse dark band, and beneath this a small triangular spot, which is usually indistinct and may be absent. At each latero-anterior angle there are two short setæ, one on each side slightly distad and nearer the meson; on each side above the base of the wing there are three very short, thick-set black setæ, two more similar setæ slightly above them and near the meson, and two larger setæ slightly above them and near the meson, and two larger setæ below them; on each side on the posterior margin there are five setæ. Scutellum yellowish-white, fringed with short and a few long setæ. On the venter there is a vertical dark band on each side between the fore and mid coxæ. Legs pale reddish-brown, sparsely clothed with setæ; those on the tibiæ and tarsi darker. Ungues black. Abdomen reddish-brown with numerous pale setæ. Wings hyaline with pale reddish-brown veins and short dark setæ on the costa. Second longitudinal vein ($R_2 + 3$) long, reaching beyond the apex of the first longitudinal vein (R_1), but not extending to the anterior cross-vein. This new species can be easily recognised

by its pale colour and dark markings on the thorax and venter between the fore and mid coxae; also by the short thick-set setæ on the thorax and pale scutellum."

8. *Hippobosca struthionis* Janson. — I have seen the type from Mt. Stewart, Cape Province, at the British Museum.

Additional Specimens Examined. — Kenya Colony: Simba, 3,350 ft.; Makumbu; Ukamba; Machakos; Athi Plains, off horse; Merifano (McArthur); Taveta, off dog (C. W. Woodhouse). — Tanganyika Territory: Tabora, off ostrich (J. Rodhain); north of Tarengere River (W. A. Lamborn); Sanga River, Muruangani. — Transvaal: Pretoria; Deelfontein; near Limpopo River, N. Transvaal, off ostrich (R. A. Cooley). — Cape Province: Philipsdale, Worcester; Hopetown; Campbell; Cradock (Miss J. Brincker); Erreha (E. Gough). — Bechuanaland: Ghanzi, Ngamiland (J. Maurice). — South West Africa: Otavi (J. Ogilvie); Aus (R. E. Turner); Greater Spitzkopje near Usakos, Damara-land (de Schauensee).

This species is unusual in that the preapical bristles of the scutellum are crowded together in two widely separated groups, placed at the extreme sides; also in that the bristles are more numerous in the male than in the female. In 23 specimens (13 ♀ and 10 ♂) examined, from 4 localities, the bristles varied in the females from 4 to 12, 9 of the 13 ♀ having from 5 to 7; in the males, from 8 to 15, 7 of the 10 ♂ having from 9 to 12. The grouping was as follows: with 4 bristles: 2 (♀); 5b.: 3 (♀); 6b.: 3 (♀); 7b.: 3 (♀); 8b.: 1 (♂); 9b.: 4 (1 ♀, 3 ♂); 11b.: 2 (♂); 12b.: 3 (1 ♀, 2 ♂); 13b.: 1 (♂); 14b.: 1 (♂); 15b.: 1 (♂). The bristles were divided into even groups in 8 specimens, unevenly in 15, the uneven groupings observed being 2 + 3, 3 + 4, 4 + 5, 5 + 6, 5 + 7, 6 + 7, and 7 + 8.

The structure of the abdomen of *H. struthionis* is similar to that of *H. variegata* in both sexes. The species has not been figured adequately.

The parameres of the male genitalia are slender, rod-like, gradually narrowed from the base to the pointed, sharp apex, and very similar to those of *H. equina*.

9. *Hippobosca camelina* Leach. — I have seen Leach's type, at the British Museum.

Additional Specimens Examined. — Morocco: Debdou-Taourirt (Ebner); Tendirara (Ebner). — Mauretania: Between Kiffa and Tidjidja, off camels (Mrs. Mary Steele). — Algeria: Biskra (Rothschild and Hartert); Ain Sefra (Rothschild and Hartert); Touggourt (Rothschild and Hartert); Oued Nça, Mزاب country (Hartert); Zahrez Gharbi (Zerny). — Tunis: Gabes (Mik); Tozeur (G. F. de Witte). — Libya: Tripoli (Klaptocz); Dernah (Klaptocz); Bengasi (Klaptocz). — Egypt: Old Cairo, off horse (Efflatoun Bey); Gebel Elba, S. E. Desert (Tewfik); near Pyramids (Reimoser). — Palestine: Jericho (P. A. Buxton); Jerusalem (P. Barraud). — Arabia: Djedda (H. W. Whyte); Tuwaiq, Riyadh (H. St. J. B. Philby); Keshin (Hein). — British Somaliland: without more definite locality (C. L. Collenette). — Kenya Colony: Lodwar, Turkana; Marsabit, Rendili Nyoro, N. Frontier District (C. A. Neave); near mouth of Kallilokwelli River, Lake Rudolf (E. B. Worthington). — Anglo-Egyptian Sudan: Khor Hanoieit, Port Sudan; Erkowit, Red Sea Hills, biting man (J. G. Myers).

H. camelina is in many respects the most aberrant member of the genus, particularly in the arrangement of the scutellar bristles and in the structure of the abdomen, both features showing remarkable sexual differences. If few specimens were examined, one might be led to think that two species are confused under the name *camelina*. Fortunately I was able to study a series of 20 specimens (10 ♀ and 10 ♂), collected in one locality of British Somaliland, removing all doubt in the matter.

In the male the scutellar bristles are preapical, placed as in the other species of the genus. In 14 males examined, from 4 localities, their number varies from 11 to 22, with the following groupings: 11 bristles: 1; 12b.: 4; 14b.: 2; 15b.: 4; 16b.: 1; 17b.: 1; 22b.: 1. They are divided into two even groups in 6 males, unevenly in 8. In the female the bristles are discal, placed near the middle of the scutellum and much more spaced. In 17 females, from 6 localities, their number varies from 3 to 8, as follows: 3 bristles: 1; 4b.: 6; 5b.: 4; 6b.: 3; 7b.: 2; 8b.: 1. They are evenly divided in 10 females, unevenly in 7.

In the female the dorsum of the abdomen is entirely soft

and extensible behind the usual basal tergal sclerite; posteriorly one finds on the extreme sides two pairs of subapical strongly sclerotized plates, bearing long bristles, the anterior pair being much larger than the posterior pair. In the male there is immediately behind the basal tergal sclerite a large ribbon-like median plate, somewhat triangular medially; much farther back, also a pair of very small median plates, rather far apart; two pairs of subapical plates are present, but the posterior pair are very small and hidden from view in a dorsal aspect. The abdomen is fairly correctly drawn for both sexes by Massonnat (1909, *Ann. Univ. Lyon, N.S.*, CXXVIII, Pl. III, figs. 24 and 25).

The parameres of the male genitalia are peculiar. They are rod-like seen from above, but in side view more or less boat-shaped; the basal two-thirds are wide, with an evenly convex lower margin; the slender apical third is curved upward and ends in a blunt, somewhat knob-like point. The outer surface is raised into a median, curved, blunt ridge, running the whole length.